FINITE ELEMENTS ANALYSYS OF GIANT MAGNETOIMPEDANCE MULTILAYERS

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Magnetoimpedance phenomenon (MI) consists in the change of the complex impedance of a ferromagnetic conductor under application of external quasistatic magnetic field or stress [1]. Due to the record sensitivity (of the order of 500%/Oe), this effect attracted attention of many researchers in the field of magnetic sensor technology [2]. The impedance depends on the properties of the material through the classic skin penetration depth $\delta = (c/2\pi)(\sigma\mu f)^{1/2}$, where c is the velocity of light, σ is a conductivity, μ is a dynamic magnetic permeability and f is a driving current frequency [3]. Sensitivity of MI elements with respect to external magnetic field depends on above mentioned parameters, which in their turn depend on the materials constants and fabrication conditions, such as: chemical composition, topology, magnetic inhomogeneities, geometrical parameters of the element etc. It is quite difficult and expensive to carry out experimental studies of each parameter separately. Finite element method is such case is useful and fast research tool to analyze certain parameters and make MI behavior prediction. Classic MI multilayer consists of two magnetic multilayered structures with well defined magnetic anisotropy with central conductive lead.

The aim of this work is to create a universal model of MI multilayers using finite element method for high-frequency current distribution description by Maxwell's laws and taking into account the magnetostatic interaction described by the Landau-Lifshitz equations.

The modeling was performed by finite element method (FEM) using the licensed software Comsol©. The calculations were performed on a specialized engineering server based on four processors Intel Xeon E5 and 124 Gb RAM, adapted for parallel computations. Such hardware allows analysis of individual layers with nanometer dimensions and the number of elements in the mesh structure more than 10^6 cells. The designed model allows calculations of the current density, the outside magnetic flux, resistivity heating for each one of the created cells and total value by integration of sub-domains. Fig. 1 shows selected examples of FEM calculations for permalloy/copper/permalloy mltilayered structure.

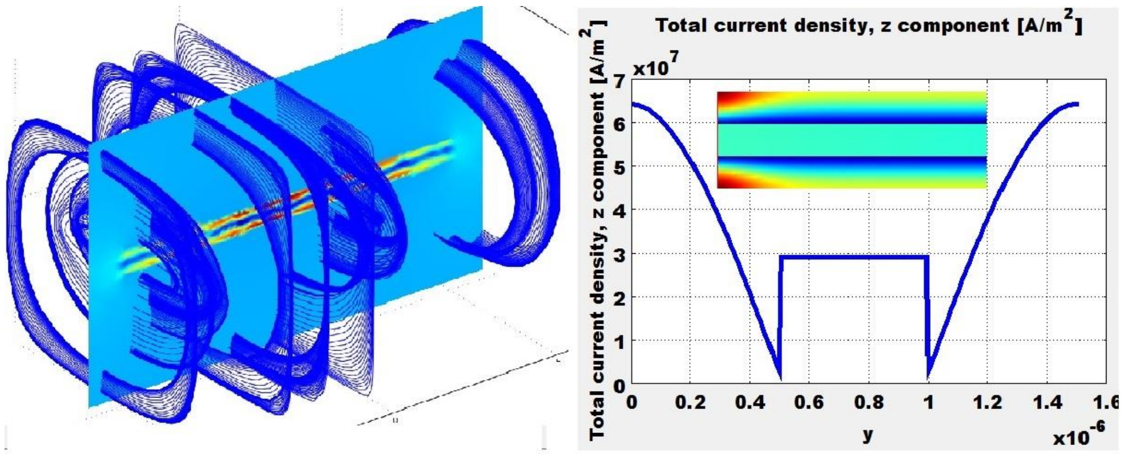

Fig. 1. (A) Outside circumferential magnetic flux density and (B) cross-section current density of FeNi/Cu/FeNi multilayer under external magnetic field of 5 Oe.

This work was performed under financial support of The Ministry of Education and Science of the Russian Federation, project № 2582.

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ОСОБЕННОСТИ СТРУКТУРЫ И СВОЙСТВА КОМПОЗИТНЫХ ПЛЕНОК 3D-МЕТАЛЛОВ

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STRUCTURE FEATURES AND PROPERTIES OF THE COMPOSITE FILMS OF 3D-METALS

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In this work features of granule formation, hysteresis and resistive properties of the (Co, Fe, $Co-Fe$, Ni, $Fe-Ni$)-(SiO_2, Al_2O_3) films of different composition have been investigated

Композиты 3d-металл – диэлектрик известны как гранулированные магнитные среды, представляющие интерес для изучения индивидуальных и коллективных свойств магнитных частиц, зафиксированных в твёрдой матрице. В то же время гранулированные пленки имеют потенциал практического примене-